

# NASA NDE WORKING GROUP NEWSLETTER

January 1994

Quarterly Newsletter

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### *NASA HQ MESSAGE, N. Schulze 202-3.58-0.5.37*

The Headquarters Office of Safety and Mission Assurance (Code Q) has four operating divisions as the result of the recent reorganization. The Associate Administrator for Code Q is Mr. Frederick D. Gregory and the Deputy Associate Administrator is Dr. Michael Greenfield. The NDE program is under the Engineering & Quality Management Division (QW), and its director is Dr. D. Mulville. The other divisions are: Payload s&Aeronautics Division, (QT), Dr. M. Greenfield, Acting Director; Space Flight S&MA Division (QP), R. Perry, Director; and Safety and Risk Management Division (QS), J. Lloyd, Acting Director. Code QW essentially combined the activities of two previous divisions, QE and QR. Other operating units include the Resources Management Office (QM) under D. Moore; the Software IV&V Facility (QV), under C. Mertz; and the Aerospace Safety Advisory Panel, Interagency Nuclear Safety Review Panel, and Space Flight Safety Panel.

As the NDE Working Group Code Q Standing committee moves into the final stages of the 1<'01" review process it may be helpful to understand the current POP 94-1 Call timetable. The OSMA RTOP objectives are currently being finalized by the AA, Deputy AA, Division Directors, and QM. The POP 94-1 Call Letter is scheduled to be sent to the Centers in early February, with final Center RTOP submissions due to QM on March 25. Center presentations via VITS are scheduled for March 28-30, and Division RTOP recommendations due to QM by April 15. The AA POP Call decisions are scheduled for April 22. During the subsequent three weeks, reclama actions by Divisions, results of 1'01" Call to Centers, and reclama actions by Centers are expected to be completed. A significant variance in the schedule is not anticipated.

Please don't hesitate to call me (202-353-0531) or FAX to me (202-358-2462) for questions [hat you may have regarding this information, or any issues which you wish to discuss

### ***NNWG HIGHLIGHTS***

***R. Neuschaefer, 202-544-7382 or M. Prebilsky, 713-483-7134***

The NASA NDE Working Group (NNWG) welcomes the transition of Mr. Norman Schulze as the Headquarters interface for NDE. Based on his guidance and the consensus of the Code Q Standing Committee under Hector Delgado, guidelines and criteria for the assessment of candidate RTOPs were established. Candidate RTOPs have been received and the evaluation/prioritization process is underway. The review of the RTOPs and the final voting by the members of the Code Q Standing Committee is planned on January 26, 1994.

The Working Group agreed on the policy for participation of contractors in the NNWG activities and to accept the Strategic Thrust portion of the S&MA Strategic Plan as written.

The NNWG also agreed to accept the Agency responsibility for review of NDE specifications and standards following a recommendation to do so by the NASA M&P Standards Committee.

### ***CURRENT EVENTS AND ACTION ITEMS***

#### ***NASA NDE DIRECTORY***

Mr. John Larson, KSC, completed the compilation of the NASA NDE Directory. Recently, he has started processing the Directory through the KSC publication chain with a target for distribution before the end of February 1994.

#### ***NASA- WIDE NDE SPECIFICATIONS***

in the 1st NASA M&P Standards Video Teleconference, that was held on Dec. 2, 1993, the NASA M&P Standards Committee has decided to transfer the responsibility to NDE Standards and Specifications to NNWG and to have Dr. Y. Bar-Cohen as the liaison. In response, NNWG has taken the following steps:

1. NNWG is taking responsible for the formation of NASA Wide NDE Standards.
2. Dr. Bar-Cohen was elected to coordinate the NASA NDE Standards activity.
3. A list of the NASA centers NDE standards/specifications were sent to JPL by Jan. 4, 1994 and the list is being compiled.
4. NNWG will inform ASNT of its interest in being involved in any future evolution of the personnel certification standard SNT-TC-1A.

Special thanks to Dr. W. St. Cyr, SSC, M. Prebilsky, JSC, R. Neuschaefer, MSFC, J. Segreto, ARC, Bradford Parker, GSFC, and J. Reagan, LeRC for their input to the NASA wide list of NDE standards.

The NDE standards for composites using ultrasonics and radiography have been reviewed by members of JANNAP and NNWG would like to acknowledge the contribution of Julian H. Sparrow of NIST and of Bernie Strauss of the Army Materials Testing Laboratory. Moreover, special

thanks to Dr. Dick Bossi of Boeing for his comments and his detailed input to the radiography standard. Recently, Mr. Monte McAndrew of Martin Marietta Manned Space System offered the willingness of the Aerospace Industry Association Working Subcommittee #4 on NDE to review and provided needed input to NASA NDE specifications.

## **NA SACENTERS NEWS AND ANNOUNCEMENTS**

### ***ARC, John Segreto, 415-604-4112***

**WIND TUNNEL WELD REPAIRS IS TAKING PLACE AFTER AN EXTENSIVE NDE:** Major weld repairs to longitudinal and circumferential shell plate butt welds on the Unitary Plan Wind Tunnel has begun as part of the first phase of the Unitary Modernization Project. NDE were performed in 1989-1992 and determined that approximately 10,000 feet of rejectable indications existed in the 33,000 feet of butt welds. All weld repairs will be inspected radiographically.

### ***GSFC, Dr. E. James Chern, 301-286-5836***

**GSFC PERSONNEL CERTIFIED AS ASNT LEVEL III IN UT AND EC:** For effective flight project support, GSFC NDE personnel are urged to enroll NDE training and be certified in their respective technical field. In December 1993, Dr. E. James Chern has received an ASNT Level III Certificate (J M- 1785) by examination in Ultrasonics and Eddy Current methods. Although the applicability of an ASNT Level III certificate to NASA programs was debated during the last NNWG telecon, this certification is the only one recognized worldwide. Dr. Yoseph Bar-Cohen of JPL, Shakeel Razvi of MSFC and Charles Salkowski of JSC also hold ASNT Level III Certificates in various NDE methods.

### ***JPL, Dr. Y. Bar-Cohen, 818-354-2610***

**ASNT TOUR OF JPL AND ITS NDE LAB DURING THE 93<sup>RD</sup> FALL CONFERENCE:** On Nov. 8, 1993 a group of 43 attendees of the ASNT Fall Conference visited JPL. Tim O'Donnell, Deputy Section Manager, Space Materials Science and Engineering Section, welcomed the visitors and reviewed JPL functions, objectives and history. Mr Jim Schroeder explained the role that JPL is playing to support industry in becoming more competitive through the Technology Affiliates Program, one mechanism of obtaining JPL technological assistance. Then, the visitors viewed a Multi-Media presentation entitled "Welcome to Outer Space" and a computer processed 3-D movie of the Los Angeles arc-a from space. Later, the visitors visited the Spacecraft Assembly and Test Facility and saw a mock-up of the CASSINI spacecraft which is scheduled for launch in 1996. The tour ended at the Materials Characterization Lab that includes the NDE and Active Materials/Sensors testing facility. The visitors were shown the recently developed system of measuring composite materials elastic properties with an access from a single side. Further, a demonstration was made showing the performance of the recently installed computer controlled contour-following APT C-scan system.

**JPL HAS SELECTED TWO FOR PHASE II SBIR CONTRACT DEVELOPING A HEALTH MONITORING SYSTEM:** Innovative Dynamics, Inc. (IDI) has recently completed Phase I program, of demonstrating the feasibility of an innovative spacecraft health monitoring concept utilizing smart composite structures and vibration signature analysis techniques. This program was

funded under the Small Business Innovative Research (SBIR) program. The objective of the Phase II program is to develop a prototype health monitoring system for spacecraft applications. A representative composite spacecraft component will be selected, designed and fabricated for demonstration.



Tim O'Donnell Speaking to the ASNT visitors at the JPL von Karman Auditorium

*JSC, Marie A. Preilsky, 713-483-7134*

JSC HAS NOW THE ONLY NASA NDE LAB ACCREDITED FOR BOTH A2LA AND ISO CERTIFICATIONS: JSC Analysis and Test Laboratory (JATL) was accredited for mechanical testing by the American Association for Laboratory Accreditation]] (A2LA) in 1991. The accreditation was expanded in July 1993 to include NDE. The scope of the NDE activities now accredited includes: RT, PT, MT, UT (thickness), ET (crack detection, conductivity, coating thickness verification and sorting). Standards followed to perform this testing include ASTM, SAE and MIL-STD's. The assessor report stated that "superior capability was demonstrated in the NDE area. Procedures were documented and well carried out with superior equipment." Further, on Dec. 10, 1993, the JATL passed the final assessment and received the official ISO-9002 registration. JSC acknowledges that JATL is the only NASA lab accredited to either of these certification bodies and we are proud of our lab personnel for their distinction. We hope they are only the first of many NASA labs to meet these standards.

#### KSC

KENNEDY SPACE CENTER NDE LABORATORY UPGRADES ITS COMPUTER TOMOGRAPHY SYSTEM (*J. Larson 407-867-3423*): The KSC NDE laboratory has recently completed upgrading the computer tomography system. The upgrade consisted of modifying the image processing system, resulting in sharper images and a 75% faster image processing speed.

Recent test with this unit consisted of scanning a thruster tube for JSC as a cooperative technical data exchange.

WINDOW DEFECT ANALYZER WAS INSTALLED AND TESTED SUCCESSFULLY (*Hector Delgado, 407-867-316.?*): The KSC developed Window Defects Analyzer was successfully installed and tested on Columbia (OV-102.) on Dec. 15, 1993. The device was installed and surface defects on the Orbiter Window NO. 4 were scanned. All objectives were met and the next milestone is for another installation on Endeavor (OV-105). Using both The Scanner and the measuring device for flaws. This is presently scheduled for late Feb. 1994.

**LaRC, E. I. Madams, 804-864-4970**

NESB\* ASSISTS THIOKOL CORPORATION WITH MEASUREMENT ON RSRM SEGMENT (*E. I. Madaras, and R. P. Minis, Lockheed*): NESB is assisting Thiokol Corporation to find a small neoprene rubber inclusion that was broken off a casting equipment and has been accidentally casted into an aft RSRM motor segment. Failure to find the inclusion will result in the segment being "washed out" with a loss to Thiokol of \$4M. NESB personnel assembled a special ultrasonic system that is capable of finding a 1 / 16" thick 1.5" X 12" neoprene rubber sheet embedded within a sample containing live fuel manufactured by Thiokol Corporation. Subsequently, at Thiokol's request, Dr. Eric Madaras visited Thiokol on November 15, 1993 with the specially developed ultrasonic system and started measurement on the Aft Segment. Thiokol personnel were trained by Dr. Madaras in using the system and they are continuing the measurements in an effort to locate the inclusion.

THERMAL BOND INSPECTION SYSTEM SHOWCASED AT THE TECHNOLOGY 2003 EXPOSITION (*K.E. Kramer*): The Thermal Bond inspection System (TBIS) was featured as part of the LaRC technology displayed at the Technology 2003 Exposition, that was held from December 6 to 10, 1993, in Anaheim, California. Technology 2003 is NASA's premier technology transfer exposition and attracts exhibitors and visitors from the worldwide aerospace community. A live demonstration was made of the TBIS, an infrared imaging system developed by NESB to characterize disbanding and corrosion in lap joints of aging aircraft. This exposition presented an excellent opportunity for interaction with representatives from a number of airlines and airframe manufacturers, as well as initiating contact with several companies interested in commercialization of the TBIS technology. More than 30 inquiries for additional information were received from visitors to the exhibit.

VISIT BY KRAUTKRAMER-BRANSON PERSONNEL FOR TECHNOLOGY TRANSFER (*M. Namkung; C. G. Clendenin; J. P. Fulton; S. Nath; R. T. Todhunter, AS&M, and J. W. Simpson, Lockheed*): Dave Jankowski (Eddy Current manager), Brian Mead (Director for Marketing) and Jeff Anderson (Director for Engineering) from Krautkramer-Branson, visited LaRC to learn the details of the Simpson probe, as a result of '91'S exhibition and the follow-on technology transfer briefing. These visitors, from this major NDI instrument manufacture, were particularly impressed by the simplicity of the instrumentation and test procedures. They showed a strong interest in commercializing the method and wanted to borrow one of the instruments for a short period of time.

\* NOTE: NESB - Nondestructive Evaluation Science Branch, LaRC.

*LeRC, A. Vary, 216-4.33-6019 or Dr. G. Baaklini, 216-4.??-6016*

**ACOUSTO-ULTRASONICS MONITOR ACCUMULATION OF DAMAGES IN CERAMIC MATRIX COMPOSITES:** Acousto-ultrasonic (AU) technique was used to assess damage, before, during and after tensile testing of three different ceramic matrix composite (CMC) systems. These composites are 1D (unidirectional) SiC/CAS, 1D dual fiber SCS6/Nicalon/LAS and 2D plain weave-SiC/SiC. In-situ AU measurements were performed throughout loading by holding the loads at intervals to prevent interferences from acoustic emissions. In-situ optical microscopy was also used to monitor failure as well as substantiate AU findings and related analysis. AU attenuation, as measured by stress-wave-factor (SWF), was sensitive to matrix cracking and the damage progression to failure. Further, real time, AU allowed the study of failure mechanisms and modeling the stress-strain response of CMCs. This technology is being applied in collaboration with the LeRC industrial partners (GE and P&W) to evaluate the combustion materials in the Enabling Propulsion Material (EPM) Program.

**ULTRASONIC VELOCITIES CHARACTERIZE OXIDATION DAMAGE IN CERAMIC MATRIX COMPOSITES VIA ELASTIC CONSTANTS CALCULATIONS:** By measuring the angular dependence of ultrasonic wave velocities the composite elastic constants can be determined. Some of these constants are more sensitive than others to different damage mechanisms and interfacial properties. This technology was refined and applied to study the transition from nonoxidized to oxidized state in CMC. The time-range for material resistance to oxidation was defined at different oxidation times and temperatures. The change in interfacial properties due to thermal oxidation was also determined and served as a quantitative characteristic for oxidation damage. This technology is being applied now by LeRC industry partners (GEAI) to metal matrix composite characterization and related stress measurements.

*MSFC, R. Neuschaefer, 205-S44-7382 or Dr. S. Russell, 205-544-4416*

**DEVELOPMENT OF AN NDE PROTOCOL FOR SILICON NITRIDE BALLS:** MSFC plans to replace the current Space Shuttle Main Engine Turbopumps with a state-of-the-art turbopump which is being developed by Pratt & Whitney under the Alternate Turbopump Development (ATD) program. The Silicon Nitride balls to be used in the ATD bearings will be inspected by NDE methods developed under the auspices of MSFC and P&W. Candidate techniques include: ultrasonics, resonant frequency analysis, penetrant inspection and X-ray. Reference standards with surface defects are being prepared by Jonathan Salem of LeRC and seeded internal defects under prepared by Dr. Ken Dolan of Lawrence Livermore National Laboratories (LLNL). Dr. Eric Madaras of LeRC has had excellent results characterizing surface artifacts using SEM and SFM techniques.

**SUCCESSFUL SHEAROGRAPHIC TESTS WERE MADE ON HONEYCOMB CORE COMPOSITE PANELS:** Recently, Martin Marietta Aero & Naval Systems Division has opened an overhaul and repair facility for inspection and repair of large turbine engine composite thrust reversal panels (flaps). This company is seeking a low cost and fast method of inspecting flaps upon receiving and after repair. Under a Space Act agreement between Martin Marietta and the MSFC Technology Utilization Office, a shearographic analysis was conducted on four Gr/Ep composite panels that were damaged deliberately. All intentional and subsequent collateral damage within each panel, including delamination, were detected and was determined that shearography appears can be used to reliably and cost effectively (icier-mine the bond integrity of Gr/Ep composite panels with honeycomb core.

*COMING EVENTS (All events are based on Eastern standard time)*

March 17, 1994, 1:00 p.m. - NNWG Teleconference.

April 5-6, 1994 - The 2nd NASA Materials and Processes Meeting will be held at JSC.

March 21-25, 1994 - Spring ASNT Conference., New Orleans, LA.

April 11-14, 1994 - SAMPE, Anaheim, CA.

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***NASA NDE Working Group (NNWG) Newsletter***

This NNWG Newsletter is published quarterly by the NNWG and NASA HQ Code QW for the NASA NDE Community.

Editor: Dr. Yost, J. Bar-Cohen, J. L.

All communications should be addressed to:

NNWG Newsletter, JPL, M.S. 12S-112, 4800 Oak Grove Dr., Pasadena, CA 91109-8099,

Phone: (818)-3542610 and FAX (818)-393-S011

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